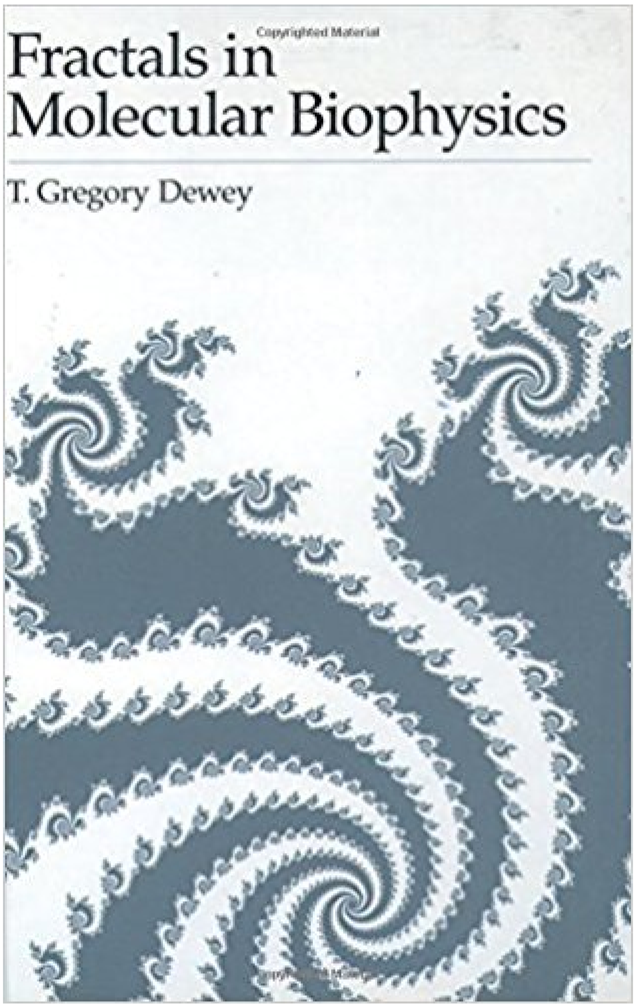
Fractals In Molecular Biophysics (Topics In Physical Chemistry)



Synopsis

Historically, science has sought to reduce complex problems to their simplest components, but more recently it has recognized the merit of studying complex phenomena in situ. Fractal geometry is one such appealing approach, and this book discusses its application to complex problems in molecular biophysics. The book provides a detailed, unified treatment of fractal aspects of protein and structure dynamics, fractal reaction kinetics in biochemical systems, sequence correlations in DNA and proteins, and descriptors of chaos in enzymatic systems. In an area that has been slow to acknowledge the use of fractals, this is an important addition to the literature, offering a glimpse of the wealth of possible applications to complex problems.

Book Information

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Customer Reviews

"The book is devoted to various applications of the modern concept of fractals to molecular, cellular, and metabolic systems. First, the basic terminology of self-similarity, polymer statistics, renormalization groups, and multifractality is introduced . . . Then temporal phenomena . . . are considered. One chapter discusses correlations and entropies of sequence data. Another chapter deals with applications of percolation theory: antibody receptor clustering, microdomains in biomembranes, and the hydration of proteins. The final chapter reviews chaos in enzymatic systems. The chapters constitute almost self-contained reviews, each with an introduction, a summary, and references. The book should be of interest to a broad readership--specialists in fractals can learn about interesting biological applications, and people familiar with biochemistry are introduced to the unifying formalism of statistical mechanics and fractals."--Mathematical Reviews"Ever since fractals became a popular concept about 25 years ago, researchers have struggled to discover how to apply the concepts to various other scientific studies. The key idea is that the fractal approach offers ways of carefully measuring the dimension and scaling properties of various phenomena in order to classify them. . . . Although the first chapter of the book summarizes fractal concepts in a fairly intuitive way, it is not an elementary tutorial. . . . Successive chapters cover protein structure, polymer statistics and loops, multifractality, diffusion, dynamics, sequence data, percolation, and chaos. Dewey has succeeded in giving a thorough account of how the tools of fractal mathematics can enhance the study of polymer structure and dynamics. The book will be most useful for researchers or serious students with a strong mathematical background."--The Quarterly Review of Biology"This is a volume in the series Topics in Physical Chemistry. It is its goal to pull together diverse applications and to present a unified exposition how fractals can be used in molecular biophysics. The book is intended for two audiences: the biophysical chemist who is unfamiliar with fractals, and the expert in fractals who is unfamiliar with biophysical problems. A theme that runs through the book is the close association of fractals and renormalization group theory, the latter being intimately associated with phase behavior of polymers and aggregates."--Quarterly of Applied Mathematics

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In other words, the "heydey" of chaos, strange attractors and fractals being applied to everything when this book was written has hit one peak, but many of the concepts in this fine volume are nowhere near antique, and new peaks, though more disperse, are still happening.Some of the author’s ideas are not only timeless, but deserve a new volume/edition or three:-- In coding/replication linearity (eg. genetics) (small inputs = small outputs) are welcome to avoid mistakes and maintain homeostasis, as in comparing strands for duplication. In adjusting to unexpected environmental change, nonlinear controls (chaotic but controlled around a strange attractor) give the option of small inputs with big outputs-- greater or more dramatic control in responding with or to, say, mutations or climate change.-- Oscillation is all about feedback, the heart of cellular switching, hardly a dusty topic today. The "dynamical systems" (not just time or power series, but ODE’s representing bigger cycles than or with oscillation) that also flourished in the early 2000’s, still have many novel and cutting edge applications in more complex areas of protein relaxation, percolation (ok, more biophysics than bichem, but hey, that’s the book’s title!), kinetics, diffusion, and one of the (still) biggest topics in biochemistry, polymers. The authors well anticipated today’s research in many of those areas. Homeodynamics hasn’t really taken over Homeostasis as they predict, but certainly has made inroads!-- Statistical mechanics, not covered as extensively as in McQuarrie (Statistical Mechanics), still has many complexity theory aspects being explored today, even though the topic also was in its heyday from the 60’s through the late 80’s (before about 1970 more often called statistical thermodynamics). The authors wryly point out the once you’ve broken down problems with as much reductionism as possible, you start running into nonlinear issues that can’t be linearized and have to be handled with complex and chaotic dynamics. Or, considered stochastic when we think they’re really determined, but are not sure how. Not perfect, but handy. Or as Box would say, wrong, but useful.Also a great foundation, even though dated, for understanding more recent journal articles on slices of the many topics covered. It is not really that complex dynamics have been abandoned, it is that they have become fractal, if not self similar, with different terms like invariance in gauge theories, etc., and thus covered in many more fragmented texts today rather than looking at great breadth with less depth.IOW it would be tough to do this volume again today, not because it is irrelevant, but because, after pulling the fragments together, it would be 20 volumes! Highly recommended for a specialized view of a specialized aspect of Biophysics and Biochem, and for fertile research areas, such as relating thermodynamic functions to quantum equations in p-chem, which is where "Probabalistic mechanics" often resides today. Eg--random/encoded walks are given a great intro here (p. 187).Library Picks reviews only for the benefit of shoppers and has nothing to do with , the authors, manufacturers or publishers of the items we review. We always buy the items we review for the sake of objectivity, and although we search for gems, are not shy about trashing an item if it’s a waste of time or money for shoppers. If the reviewer identifies herself, her job or her field, it is only as a point of reference to help you gauge the background and any biases.

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